



Sandoval Zinc Superfund Site Sandoval, Illinois RPM: Pam Molitor

Preliminary Report of Residential Soil Sampling Event, 23-26 August 2010 XRF Results

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Introduction

The FIELDS Group conducted a soil sampling event from August 23 through August 26, 2010 on residential properties in Sandoval, Illinois (Marion County) as part of the Sandoval Zinc Superfund Site evaluation. This report details the XRF levels for Arsenic, Lead, and Zinc metals in residential soils, data collection methods, and analysis performed on these data. At a later date, an additional report will detail the relationship of XRF values and laboratory values (regression). The relationship of these values will be used for decision-making purposes.

Methods

A systematic aligned, triangular gridded sample design (Figure 1) was created using the FIELDS Tools in ArcGIS to provide information on the spatial variability of metal levels in residential soil. Ninety-three sample locations were created using this design. The number of locations was based on two factors:

- spatial adequacy -- 93 properties would ensure sufficient spatial coverage in order to make defensible statistical statements. The ninety-three properties are about 20% of all residential properties in the Village of Sandoval.
- time -- 93 properties could be sampled in a two-week period by one sampling team

The results from a triangular grid allows one to:

- evaluate the spatial nature of contamination (e.g., airborne deposition)
- ensure all areas are adequately sampled

- provide probabilities of residences with elevated metal levels (e.g., above 1,000ppm Lead)
- evaluate possible causes of differences between residences with elevated metals vs. those with lower levels (e.g., existence of site-based material?)

To determine which properties would be sampled, letters requesting access were mailed out to property owners in the Village of Sandoval provided by the Marion County tax assessors' office. A much larger number of letters were mailed than the number of proposed sample locations in order to account for owners who refuse to have their property sampled, property owner changes or improper addresses, non-respondents, etc. One hundred and eighty-three residents granted access to sample residential soil. Of the proposed 93 sample locations, 69 (74%) had one or more residential properties that granted access for sampling that was nearest itself than any other sample location.

During the sampling event, the property with granted access at or closest to the proposed sampling location was used for the sampling event. At each of these properties, soil sampling was done using a coring device. Sampling was performed in two of three possible locations: front-, side-, or backyard. In general, the two largest were sampled (e.g., frontyard and backyard). In cases in which only one yard was present or accessible, only that one was sampled. In each yard, the coring device was used to penetrate the top six inches of soil in five different locations in a quincunx geometric pattern (five-on-a-die). The soil from these five different locations within a yard were added to a metal bowl, mixed together by gloved hand, and bagged to form a composite sample for XRF testing for elemental concentration levels. A composite sample is expected to provide a more precise estimate of the mean concentration than a single point sample. The X,Y coordinates for each of these five locations within the yard were collected using a Garmin 32X GPS unit and recorded in the RAT software.

At 10% of sampled residences, a drip zone sample was collected. One sample was collected under the eaves of each side of the residence (i.e., 4 samples). At 20% of sampled residences, subsurface samples were collected at depths between 6–12 inches from the original five sample locations performed first in the front-, side-, or backyard. At 10% of the sampled residences, a sample was collected at each of the five sample points (in a quincunx pattern) separately, placed into samples bags, and labeled according to the sample location. These discrete samples provide a measure of the within-yard variability of metal concentrations.

At the completion of the sampling event, 156 residential soil samples were collected representing 69 different properties.

The concentration of metals within each residential soil sample bag was evaluated using an InnovX α 4000 X-ray Fluorescence (XRF) device. The XRF sensor was placed over the bagged soil sample and “shot” in the four corners and center of the bag, again in a quincunx pattern, in order to provide a more representative metal concentration value for the entire sample. The XRF readings were recorded in the RAT software. The median of the five readings was calculated for Arsenic, Lead, and Zinc. The full limit of detection value was used for non-detects in the estimation of the median value of Arsenic, Lead, and Zinc for each sample.

In addition to XRF measurements of each sample, a subset (49; 31%) of the 156 samples was sent for laboratory analysis. A separate report will detail the correlation of samples with XRF and laboratory results.

Results and Discussion

The median XRF Arsenic concentration levels ranged from 6 ppm to 69 ppm for surface soil, 7 ppm to 40 ppm for subsurface soil, and 13 ppm to 25 ppm for drip zone soil. There appears to be a higher number of elevated XRF Arsenic values nearer to the site than farther away (see Figure 2). This pattern is also seen in the subsurface XRF Arsenic values in Figure 3. Figure 4 shows the XRF Arsenic values for drip zone samples.

The median XRF Lead concentration levels ranged from 18 ppm to 1,280 ppm for surface soil, 17 ppm to 1,252 ppm for subsurface soil, and 134 ppm to 534 ppm for drip zone soil. The occurrence of locations with more elevated Lead levels appears to be nearer to the site as shown by Figure 5 (surface soil). Figure 6, subsurface, shows a similar pattern. Figure 7 displays the XRF Lead drip zone levels.

The median XRF Zinc concentrations levels ranged from 43 ppm to 6,198 ppm for surface soil, 50 ppm to 4071 ppm for subsurface soil, and 361 ppm to 1717 ppm for drip zone soil. As with the Arsenic and Lead XRF data, higher XRF Zinc levels appear more proximal to the site (see Figure 8 and 9). Figure 10 shows the XRF Zinc levels for the drip zone sample locations. None of the XRF Zinc values were near the risk screening level (RSL) for Zinc in a residential area of 23,000 ppm.

References

FIELDs Tools for ArcGIS (<http://epa.instepsoftware.com/FIELDS/>)
RAT software (<http://epa.instepsoftware.com/RAT/>)

Contact

For further question, please contact John Canar (bing-canar.john@epa.gov) or Charles Roth (roth.charles@epa.gov) about this document.

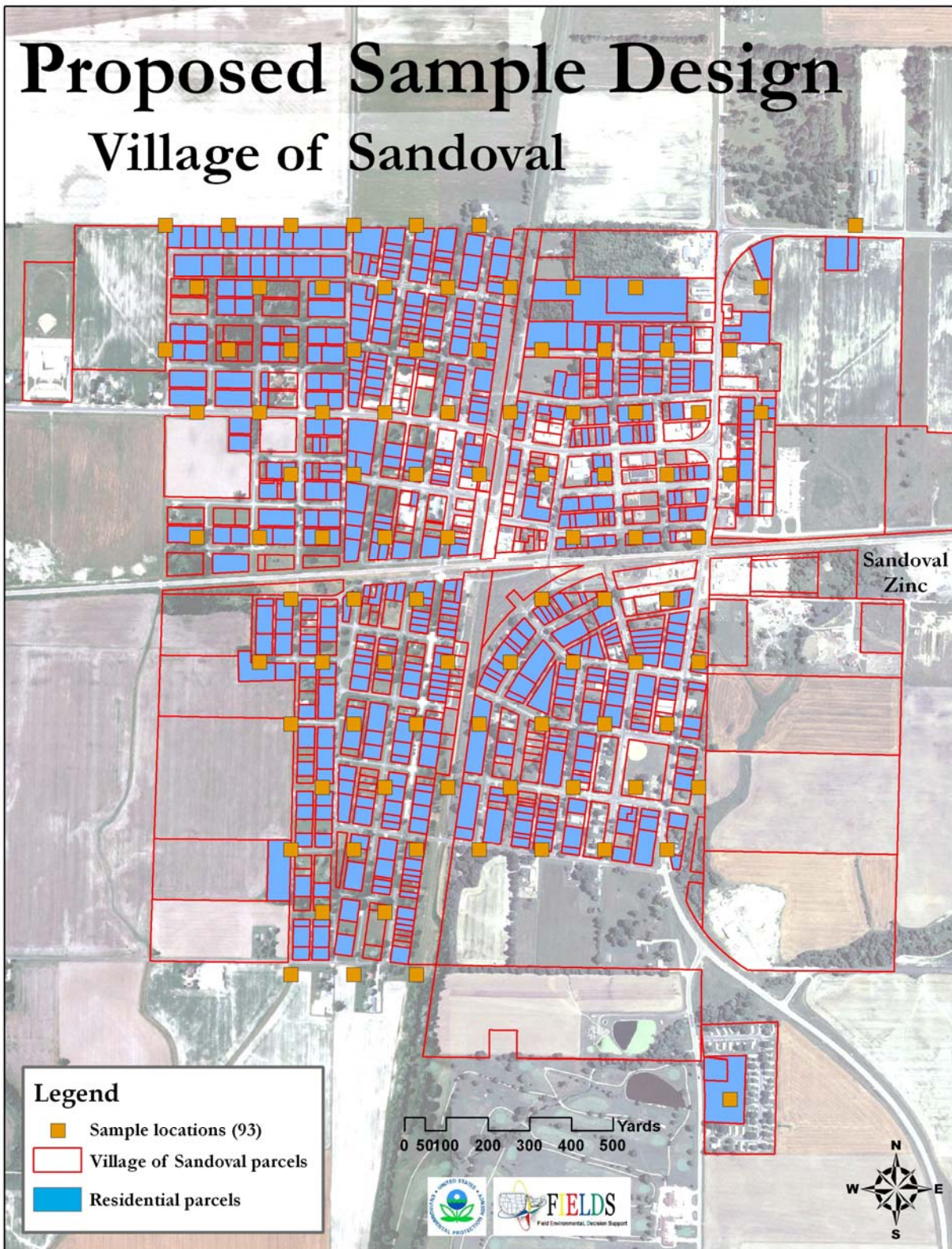


Figure 1: 93 proposed sample locations created from a systematic triangular grid with a random start location (FIELDs Tools for ArcGIS) for the Village of Sandoval

Sandoval XRF Arsenic Values (Surface)

Sampling Event from the
Week of August 23rd, 2010

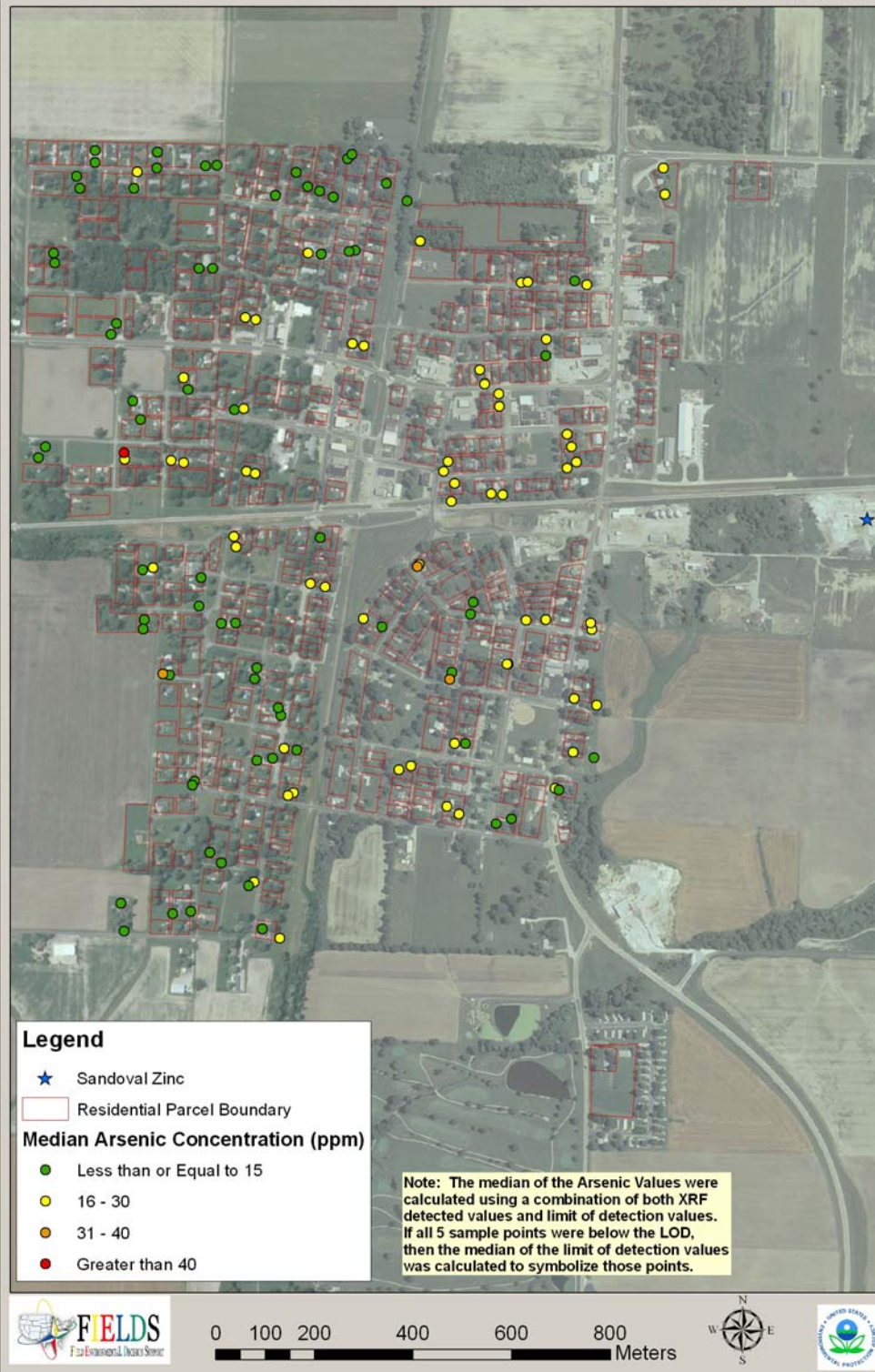


Figure 2: Median XRF Arsenic Concentration Levels for Surface Sample Composites.

Sandoval XRF Arsenic Values (Subsurface)

Sampling Event from the
Week of August 23rd, 2010

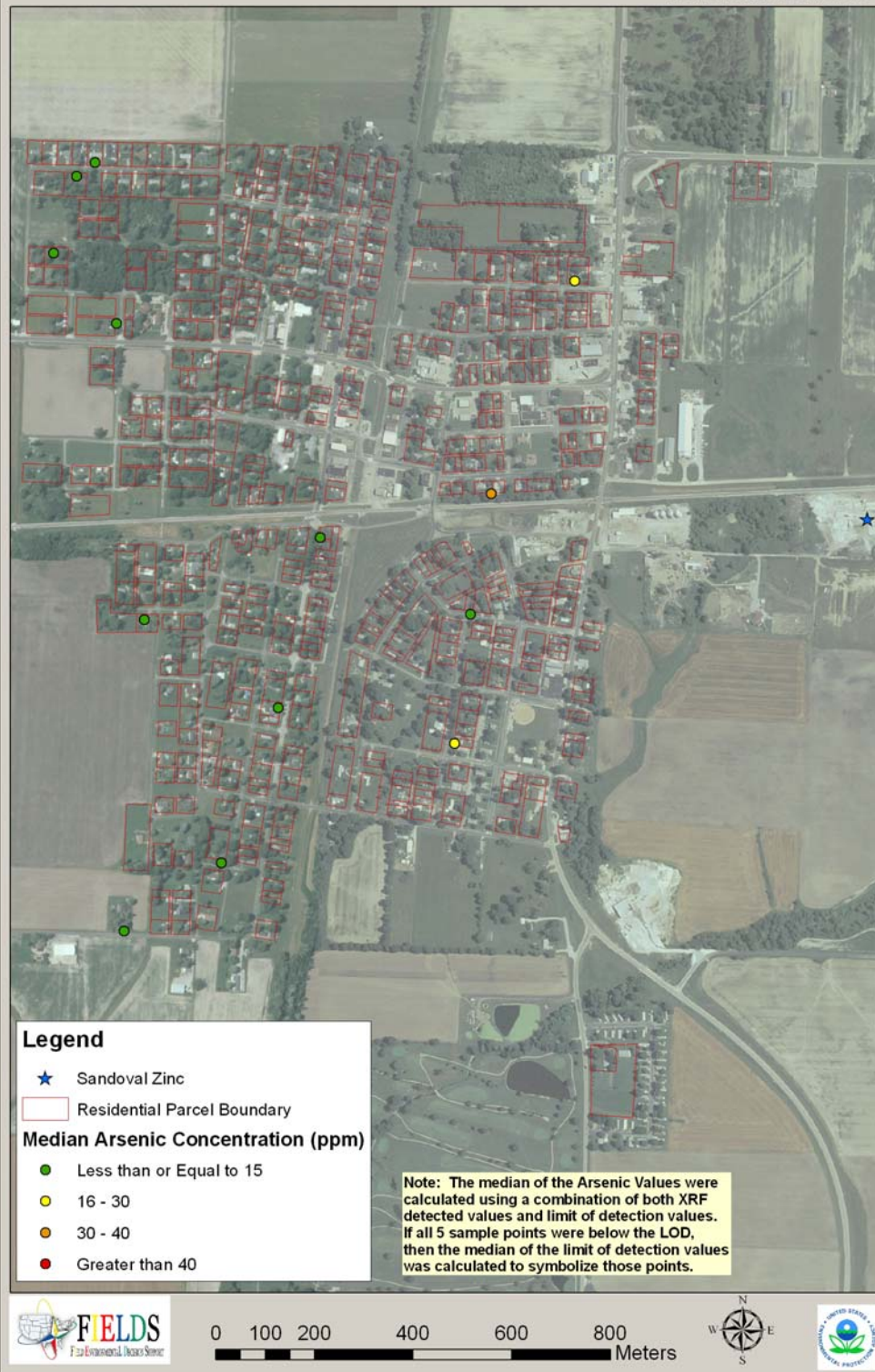


Figure 3: Median XRF Arsenic Concentration Levels for Subsurface Sample Composites.

Sandoval XRF Arsenic Values (Drip Zone)

Sampling Event from the
Week of August 23rd, 2010

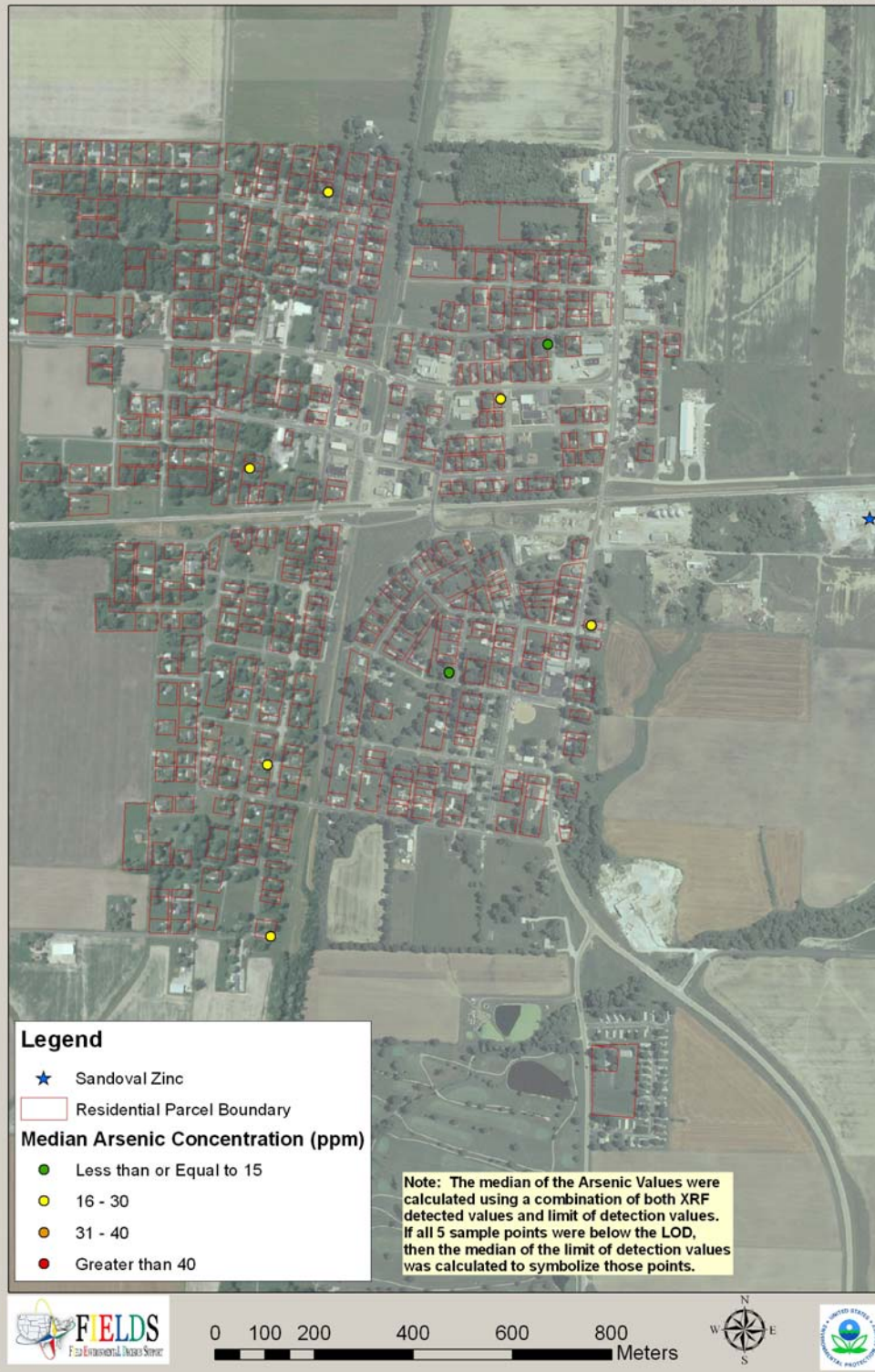


Figure 4: Median XRF Arsenic Concentration Levels for Drip Zone Sample Composites.

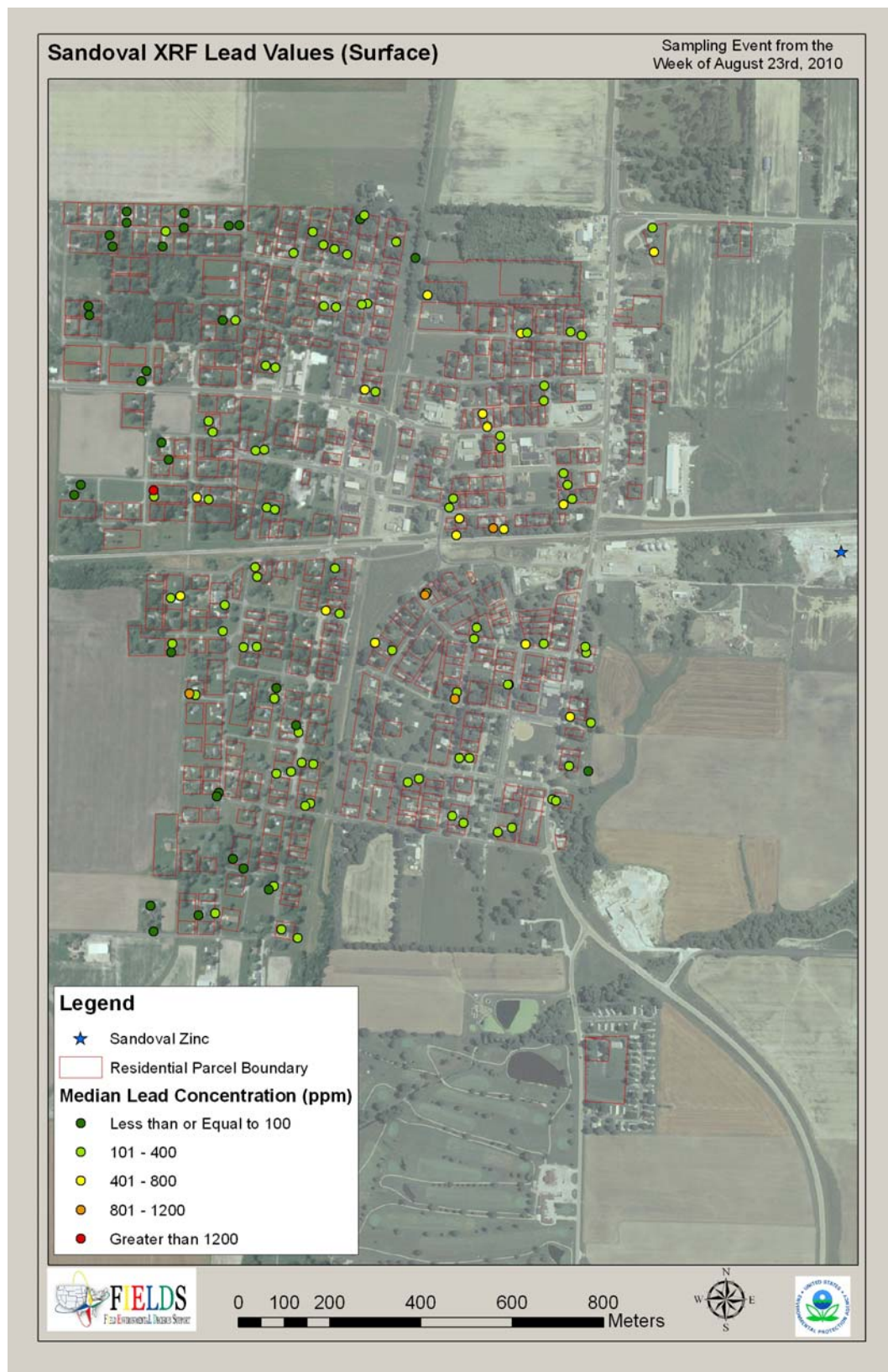


Figure 5: Median XRF Lead Concentration Levels for Surface Sample Composites.

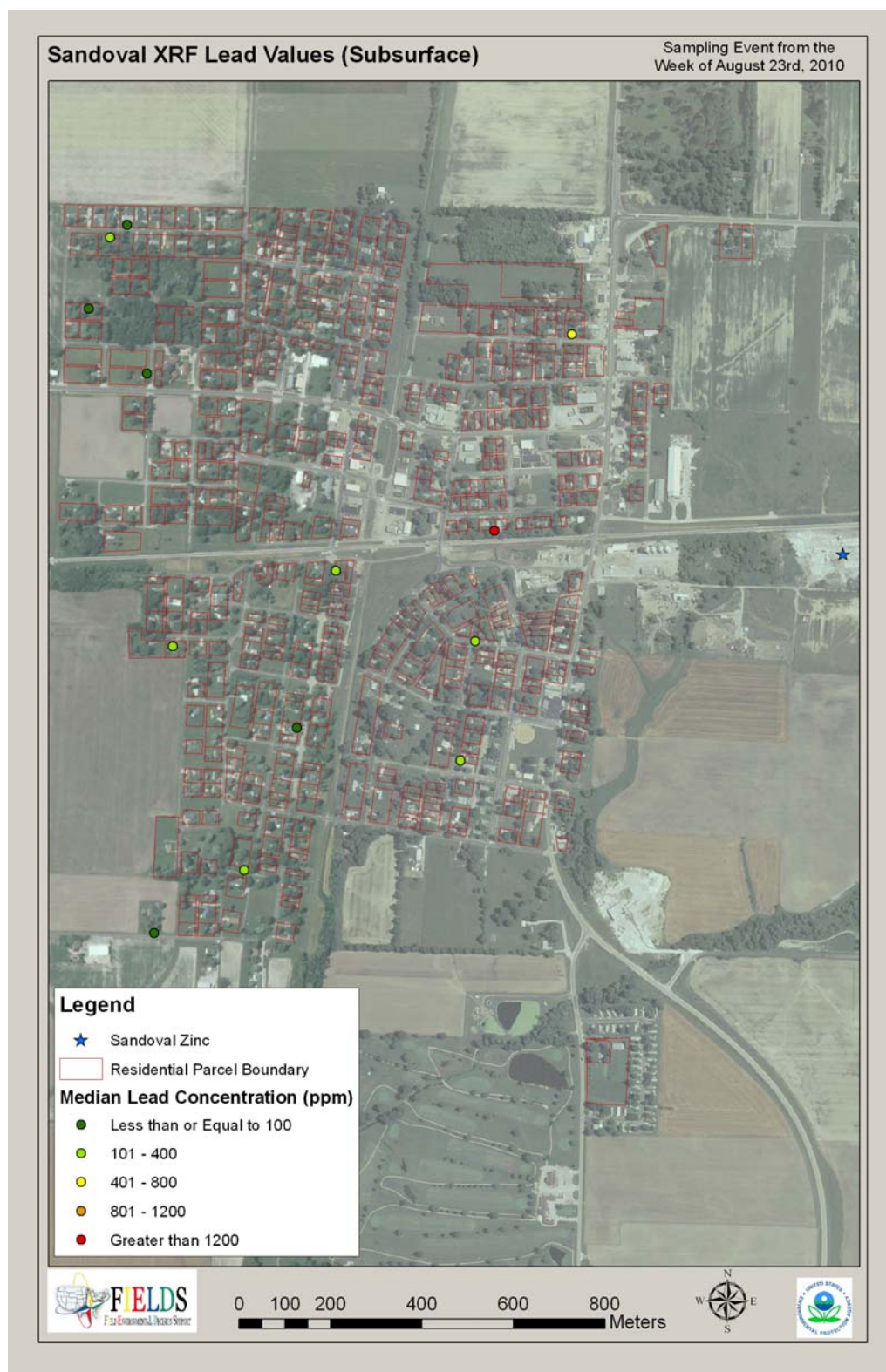


Figure 6: Median XRF Lead Concentration Levels for Subsurface Sample Composites.

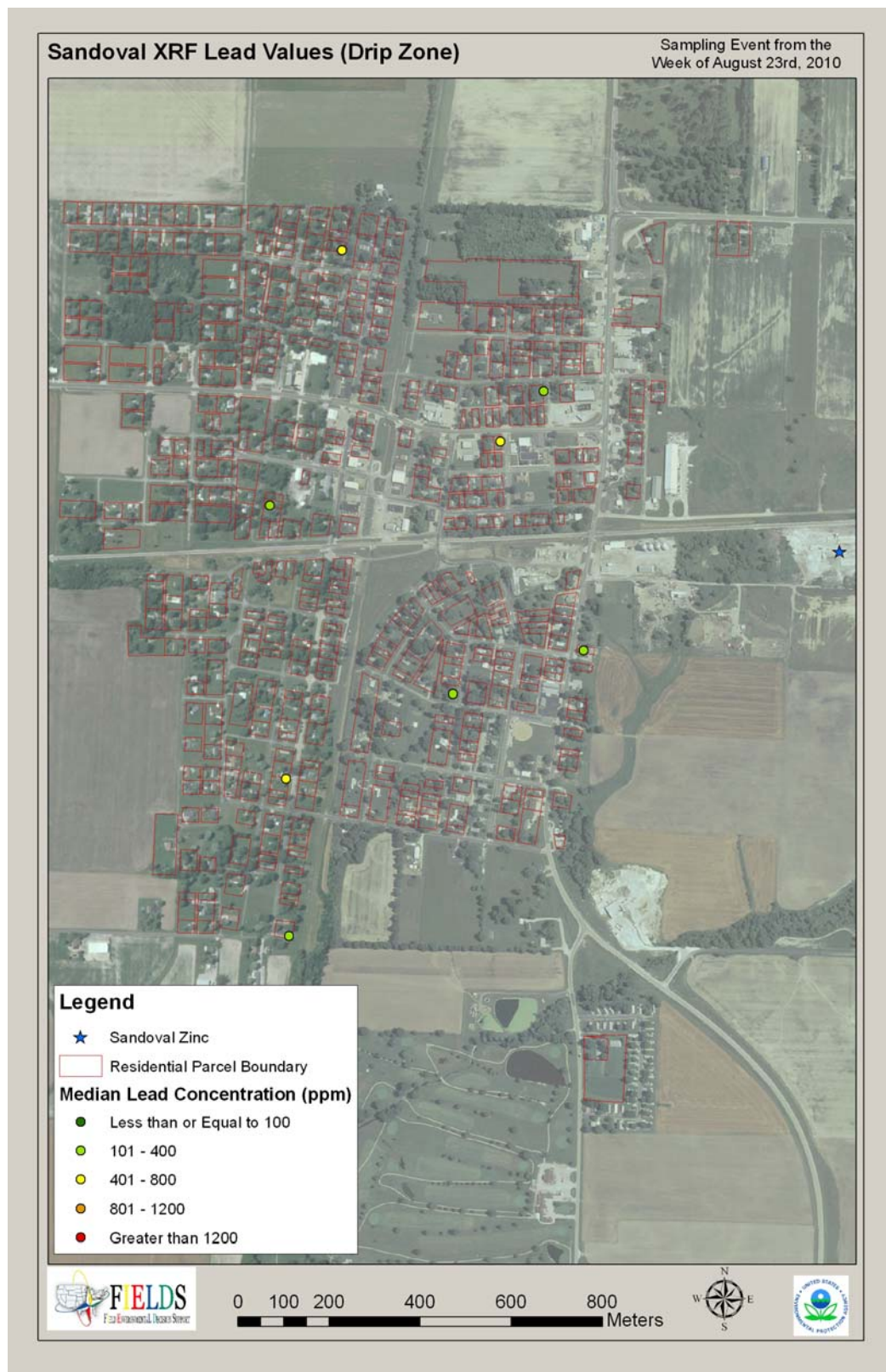


Figure 7: Median XRF Lead Concentration Levels for Drip Zone Sample Composites.

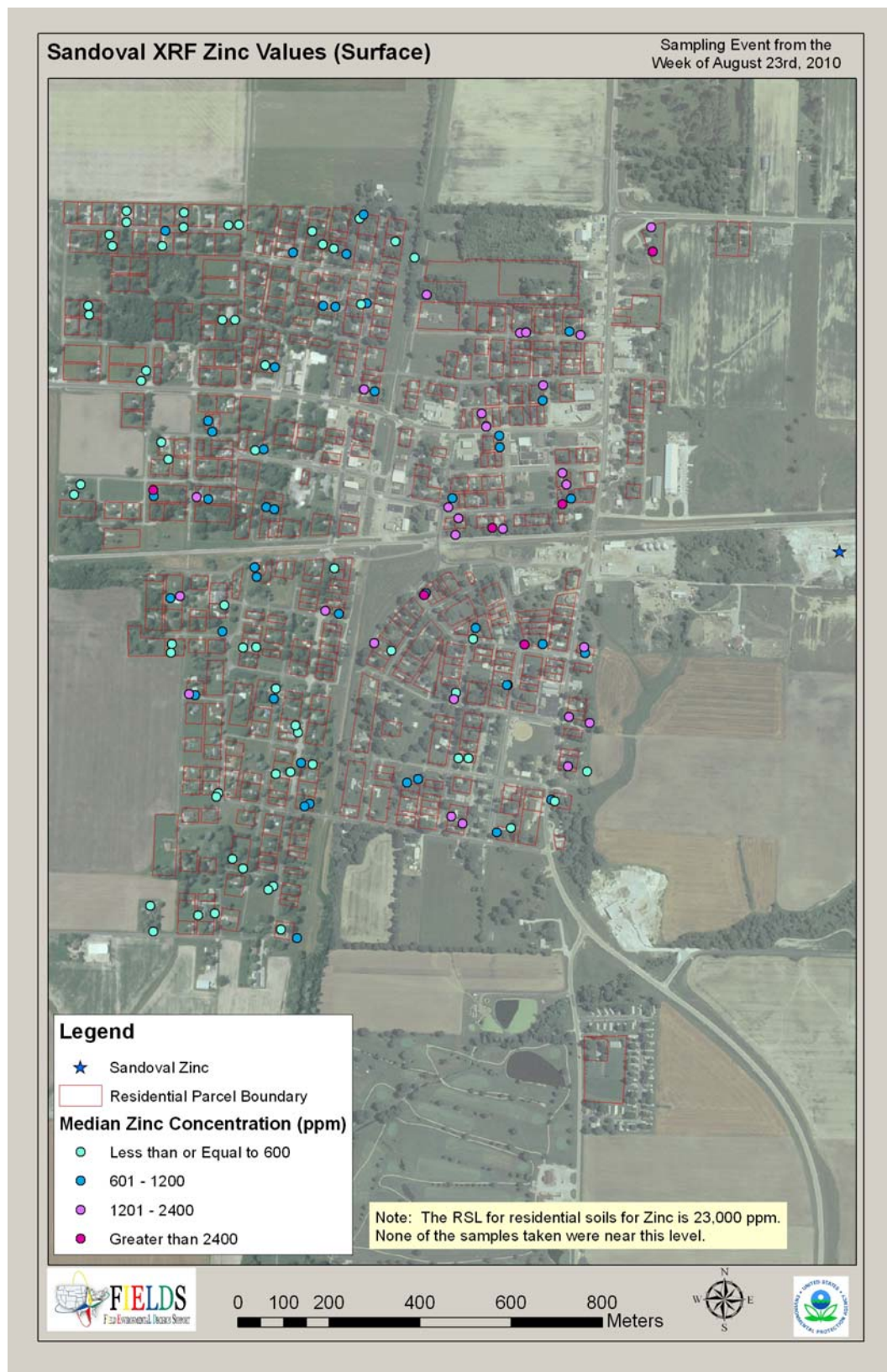


Figure 8: Median XRF Zinc Concentration Levels for Surface Sample Composites.

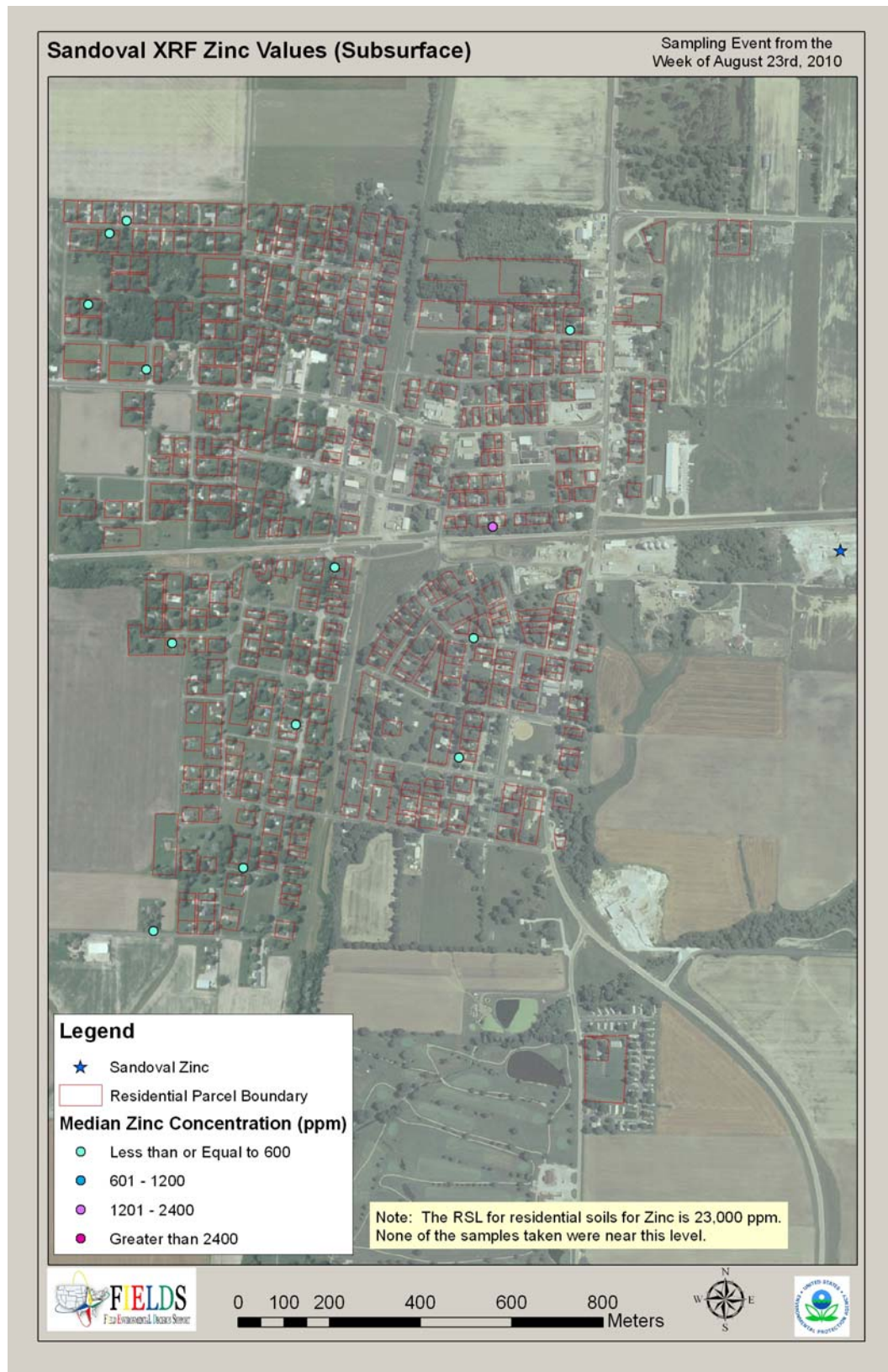


Figure 9: Median XRF Zinc Concentration Levels for Subsurface Sample Composites.

Sandoval XRF Zinc Values (Drip Zone)

Sampling Event from the
Week of August 23rd, 2010

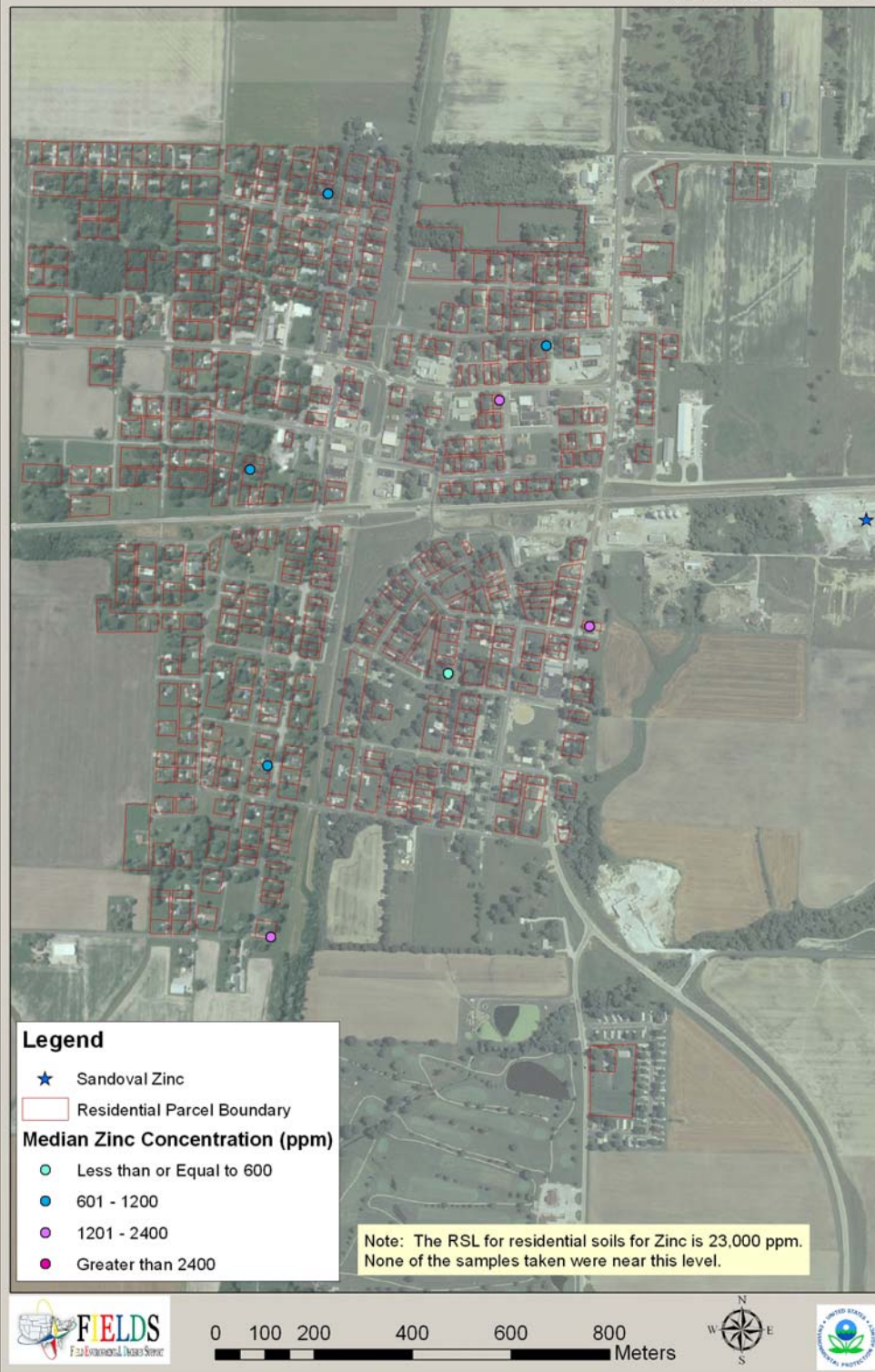


Figure 10: Median XRF Zinc Concentration Levels for Drip Zone Sample Composites.